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REVIEW

Endovascular Stent-graft Placement in Stanford Type B Aortic Dissection in China

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Abstract *Objective:* The objective of this study was to summarise data about endovascular stent-graft placement for patients with type B aortic dissection (type B-AD) in China.
Methods: All published series in Chinese on endovascular stent-graft placement for type B-AD from 1999 through 2008 were identified. Thirty-five studies, involving a total of 1498 patients, were included in this review.
Results: Procedure success was reported in 89.4 ± 1.7% of the patients. Overall complications were reported in 16.6 ± 1.2% of the patients. Major complications were reported in 1.7 ± 0.2%, with neurological complications in 0.5 ± 0.1%. In-hospital mortality was 2.0 ± 0.4%. The mean follow-up was 24.0 ± 16.1 months.
Conclusion: Endovascular stent-graft placement is technically feasible with high procedure success and relatively low complication rate in selected patient groups with type B-AD. Both short- and mid-term outcomes appear to be favourable.

Successful stent grafting of patients with acute type B aortic dissection (B-AD) was first reported by Dake and colleagues[1] in 1999; Nienaber and colleagues[2] simultaneously reported their results in patients with sub-acute and chronic type B-AD. Eggebrecht et al.[3] performed a meta-analysis of stenting for aortic dissections with descending tears and showed a procedure success in 98.2%, stroke in 1.9% and paraplegia in 0.8% of the patients. Wang et al.[4] and Jing et al.[5] independently published the preliminary experience of endovascular stent-graft placement for type B-AD patients in China in 1999. Later, many studies have been published in Chinese-language publications. This article summarises all the data currently available about endovascular stent-graft placement for patients with type B-AD in China.

Materials and Methods

Data sources

With the search phrases 'aortic dissection' and 'stent graft' or 'endovascular', a comprehensive search of the

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Chinese-language medical literature between January 1999 and January 2008 was performed using the China National Knowledge Infrastructure database to identify all studies on endovascular stent-graft treatment for patients with type B-AD. A multistage assessment was used to include the qualified articles. At the first stage, only abstracts were reviewed. Only the articles focussing on endovascular stent-graft placement for patients ($n \geq 10$) with type B-AD were included for data extraction. At the second stage, the full articles were reviewed; only the articles with sufficient data ($\geq$40% of pre-defined variables) and follow-up longer than 1 month for each survival case were included. In the case of multiple reports of previously listed patients from a single center, only the articles with the most recent number of patients or with most information were included.

Definitions

Aortic dissection (AD) was classified according to the Stanford classification. It was considered acute if occurring within the first 14 days from onset of symptoms and chronic if it exceeded beyond that. The intervention indications for acute dissections were as follows: (1) persistent back/chest pain, (2) uncontrollable hypertension, (3) malperfusion syndrome, (4) rupture and (5) a maximal aortic diameter $\geq$5 cm. The indications for chronic dissections were: (1) psuedo-aneurysm with diameter $\geq$5 cm or rapid enlargement $>$5 mm per year and (2) acute symptoms. Complications were defined as major when life threatening or necessitating emergent management (e.g., stroke, access arterial damage) whereas minor ones were defined as those that may recover later without further aggressive treatment (e.g., infection of the access site). Procedure success was defined as complete coverage of the primary entry tear without a type I or III endoleak at the end of the procedure. Persistent endoleak was defined as one that still existed at the latest follow-up.

Data extraction

A standardised protocol for data extraction including 53 pre-defined variables regarding clinical characteristics, procedural data, in-hospital and follow-up data was introduced by Eggebrecht.[3] A modified standardised protocol including 47 pre-defined variables (six variables were deleted from the standardised protocol because only a few articles had mentioned them) was used to analyse each article in this review. Extraction of data was performed independently by the authors. Mutual consensus was achieved by further discussion when discrepancies occurred. Unspecified information was classified as not available (n.a); thus the number of patients (denominator) varied with the specific variables. For the studies without the required data for survival analysis, we managed to contact the corresponding authors or the first authors for supplementary materials about survival outcome.

Statistical analysis

The number of events divided by the number of treated patients with available data was used to calculate the individual rates of events. In order to avoid potential underestimation of events owing to the differing patient numbers, a worst-case model was calculated for some variables with important clinical impact. This model assumes that all reported, but unspecified, events occurred in dissection patients and provides a worst case of the rates. Results were presented as mean $\pm$ 1 standard deviation or median and range. Two-sided chi-square test for categorical variables and two-sided Student's *t*-test for continuous variable were used to compare between patients with acute and chronic type B-AD. The Kaplan–Meier non-parametric method was used to estimate the mortality, and compared using the log-rank test. A *P*-value $<$0.05 was considered statistically significant. Statistical software SPSS 13.0 was used for all the statistical analysis mentioned earlier.

Results

Studies overview

Thirty-five studies, involving a total of 1498 patients, were included in this study. For some variables only a small proportion of the data were available. General information of these studies was overviewed (Table 1).

Procedural and in-hospital data

Procedure success of 89.4 $\pm$ 1.7% was achieved. Emergent surgical conversion was required in 0.2 $\pm$ 0.1% of patients (Table 1). In-hospital complications were reported in 15.2 $\pm$ 1.1% of patients (worst-case estimate: 14.5 $\pm$ 1.1%) (Tables 2 and 3). Major complications were 0.8 $\pm$ 0.2% (worst-case estimate: 0.8 $\pm$ 0.1%), whereas minor complications were reported as 14.2 $\pm$ 1.1% (worst-case estimate: 13.5 $\pm$ 1.1%). Procedure-related complications were 1.3 $\pm$ 0.5%, with retrograde type A-AD 0.1 $\pm$ 0.03% and access complications 1.2 $\pm$ 0.5%. As shown in Table 2, 1.1 stents were used per patient, with Talent (Medtronic, USA) as the most commonly used stent graft (Table 4). The neurological complications were 0.3 $\pm$ 0.1% (worst-case estimate: 0.3 $\pm$ 0.1%); of these patients, 0.3 $\pm$ 0.1% suffered a stroke (worst-case estimate: 0.3 $\pm$ 0.1%). Paraplegia was not reported during hospitalization. Thirty of 1437 patients died during the in-hospital period, and the overall in-hospital mortality was 2.1 $\pm$ 0.4% (worst-case estimate: 2.0 $\pm$ 0.4%), with rupture of the dissection as the leading cause of death (Table 5). Two additional deaths occurred within the 30-day period, yielding a 30-day mortality of 2.2 $\pm$ 0.4%.

Overstenting of aortic branches

Intentional overstenting of left subclavian artery (LSA) without re-vascularisation was conducted in 88 patients among 1166 patients whose data were available (7.5%). Most of these patients tolerated the procedure well, except for three patients: one death each due to brain stem ischaemia (1.1%) and cerebral infarction (1.1%) and another suffered from mild left subclavian steal syndrome (LSSS) (1.1%), another underwent transient left extremity

Table 1 Detailed overview of the analyzed report

Author	Year	Patients with AD (*n*)	Proc. Success (*n*)[a]	Emergency conversion (*n*)	Overall complications (*n*)	Major complications (*n*)	Post-operative endoleak (*n*)	Overall neurologic complications (*n*)	Paraplegia (*n*)	30-day mortality (*n*)	Post-discharge surgical conversion (*n*)	Aortic Rupture during follow-up (*n*)	Post-discharge mortality during follow-up (*n*)
Jing[6]	2003	146	139	1	31	2	6	0	0	6	2	0	2
Zhang [7]	2003	44	34	0	11	1	10	1	0	2	0	0	1
Wu[8]	2004	15	15	0	0	0	0	0	0	0	0	0	0
Zhang[9]	2004	10	8	0	n.a.	0	0	n.a.	0	1	0	0	0
Li[10]	2004	11	9	0	n.a.	0	2	0	0	0	0	0	0
Shi[11]	2005	150	122	0	n.a.	2	26	1	0	1	n.a.	n.a.	n.a
Ling[12]	2005	26	22	0	n.a.	n.a.	4	n.a.	0	0	n.a.	n.a.	0
Zhang[13]	2005	12	11	0	n.a.	0	1	n.a.	0	1	n.a.	n.a	0
Guo[14]	2005	159	n.a.	0	n.a.	0	n.a.	0	0	6	0	0	n.a
Shan[15]	2005	24	21	0	n.a.	1	2	n.a.	n.a.	1	1	0	0
Su[16]	2005	22	n.a.	0	n.a.	0	n.a.	0	0	1	n.a.	0	0
Luo[17]	2006	22	22	1	1	1	0	0	0	0	0	0	0
Adil hasan[18]	2006	25	22	0	4	1	2	0	0	1	0	0	0
Li[19]	2006	39	39	0	n.a.	n.a.	0	n.a.	n.a.	0	0	0	0
Zhao[20]	2006	15	14	0	n.a.	n.a.	1	n.a.	n.a.	0	0	0	0
Tan[21]	2006	15	15	0	n.a.	n.a.	0	n.a.	0	3	0	0	0
Qian[22]	2006	20	20	0	n.a.	0	0	n.a.	0	0	n.a.	0	0
Lu[23]	2006	17	17	0	n.a.	n.a.	0	n.a.	n.a.	0	0	0	0
Li[24]	2006	17	15	0	n.a.	1	2	n.a.	0	n.a.	0	0	0
Yu[25]	2006	180	161	0	18	0	18	0	0	2	0	1	1
Wang[26]	2006	11	11	0	0	0	0	0	0	0	0	0	0
Luo[27]	2006	55	45	0	10	1	9	0	0	1	0	0	0
Pang[28]	2006	12	12	0	3	0	0	0	0	0	0	0	0
Chang[29]	2007	121	112	0	23	9	9	3	0	3	0	2	4
Sheng[30]	2007	18	16	0	2	0	2	n.a.	0	0	0	0	0
Zhang[31]	2007	17	17	0	n.a.	n.a.	0	n.a.	0	1	n.a.	n.a.	0
Yang[32]	2007	43	38	0	7	0	5	0	0	0	0	0	0
Wang[33]	2007	36	32	0	13	0	4	0	0	2	0	0	0
Dong[34]	2007	10	n.a.	0	n.a.	n.a.	n.a.	n.a.	n.a.	0	n.a.	n.a.	0
Luo[35]	2007	16	15	0	n.a.	n.a.	0	n.a.	0	0	n.a.	0	0
Zhang[36]	2007	19	19	0	0	0	0	0	0	0	0	0	0
Dai[37]	2007	61	n.a.	1	n.a.	n.a.	n.a.	n.a.	0	n.a.	n.a.	0	n.a
Yang[38]	2007	48	46	0	1	0	1	0	0	0	0	1	1
Jing[39]	2007	50	44	0	16	2	6	1	1	0	1	2	3
Zhu[40]	2007	12	1	0	n.a.	n.a.	11	n.a.	n.a.	0	n.a.	n.a.	0
All		1498	1114/1246	3/1498	140/845	21/1270	121/1246	6/1187	1/1396	32/1420	4/1152	6/1271	12/1128
			89.4 ± 1.7%	0.2 ± 0.1%	16.6 ± 1.2%	1.7 ± 0.2%	9.7 ± 1.7%	0.5 ± 0.1%	0.1 ± 0.04%	2.3 ± 0.4%	0.3 ± 0.1%	0.5 ± 0.1%	1.1 ± 0.1%

[a] Some studies just provided the number of endoleaks without classification. Considering that the case of endoleak type II or IV is rare, it was assumed that all the endoleaks were type I or III.

Table 2 In-hospital data

	Data available (*n*)	Number of events or cases (*n*%)
Procedure success	1246	1114 (89.4 ± 1.7%)
Number of stent-grafts per patient	309	1.1
Adjunctive endovascular procedures	795	4 (0.5 ± 0.2%)
Overall complications (In-hospital)	988	150 (15.2 ± 1.1%)
Major complications	1212	10 (0.8 ± 0.2%)
Minor complications	998	140 (14.2 ± 1.1%)
Procedure-related complications	1301	17 (1.3 ± 0.5%)
Retrograde type A-AD	1456	2 (0.1 ± 0.03%)
Access complications	1321	16 (1.2 ± 0.5%)
Neurologic complications	1205	4 (0.3 ± 0.1%)
Stroke	1244	4 (0.3 ± 0.1%)
Paraplegia	1411	0
In-hospital mortality	1437	30 (2.0 ± 0.4%)
In-hospital mortality, procedure related	1498	9 (0.6 ± 0.2%)
In-hospital mortality, non-procedure related	1498	22 (1.5 ± 0.4%)
30-Day mortality	1498	32 (2.2 ± 0.4%)

Table 3 Worst-case estimates

	Data available (*n*)	Number of events or cases (*n*%)
Overall in-hospital complications	1034	150 (14.5 ± 1.1%)
Major complications during hospitalization	1279	10 (0.8 ± 0.1%)
Minor complications during hospitalization	1034	140 (13.5 ± 1.1%)
Neurologic complications during hospitalization	1270	4 (0.3 ± 0.1%)
Stroke	1312	4 (0.3 ± 0.1%)
In-hospital mortality	1507	30 (2.0 ± 0.4%)
Additional late mortality over 1–72 m	801	7 (0.9 ± 0.1%)

malperfusion which was released by heparin injection (1.1%), and one experienced mild weakness of the left upper extremity (1.1%). The overall percentage of patients who had a complication because of the intentional overstenting without re-vascularisation was 5.7% (5 of 88). Re-vascularisation of LSA prior to overstenting was carried out for 14 patients among 1166 patients (1.2%), consisting of left common carotid artery (LCCA)–LSA bypass for six patients, LCCA–left vertebral artery bypass for four, right subclavian artery–LSA bypass for two patients, and unknown method of bypass for two. RCCA–LCCA–LSA bypass prior to overstenting of LSA and LCCA was carried out for one patient. Incident overstenting of LSA and LCCA happened in one patient, which was managed by emergent ascending aorta–LCCA–LSA bypass. Intentional overstenting of celiac axis with prior abdominal aorta–common hepatic artery–superior mesentery artery bypass was carried out for two patients. Incident overstenting of celiac axis was not reported. For all the cases with re-vascularisation of the overstenting aortic branches, no overstenting-related complications were reported.

Follow-up data

Fourteen studies, including 641 patients, provided the mean follow-up period of 24.0 ± 16.1 months. False lumen thrombosis was reported in 84.2 ± 1.6% of the patients (Table 6). In 0.5 ± 0.04% of the patients, post-discharge surgical conversion was needed. Post-discharge complications were reported in 3.1 ± 0.8% of the patients and post-discharge mortality was 0.8 ± 0.1%. Persistent endoleak occurred in 1.5 ± 0.3% of the patients, nine of which, according to the data available, were type I endoleaks. Stent migration was observed in 0.4 ± 0.2% of the patients. In the survival analysis, 225 patients with detailed survival data were included. The cumulative survival rates were

Table 4 Types of stents

The types of stents	The number of institutes (*n*)[a]	The number of stents (*n*)[b]	The diameter of the stent (mm)	The length of the covered stent (mm)
Talent (Medtronic, USA)	17	348	30–40	100–150
Hercules & Aegis (MicroPort, PRC)	10	123	30–44	40–160
Ankura II (Lifetech, PRC)	5	19	30–40	100–160
Zenith (Cook, USA)	3	6	28–38	77–150
Yuhengjia (Yuhengjia, PRC)	3	n.a.	24–44	60–130
Vasoflow (Vascore, PRC)	2	14	n.a.	n.a.
Endofit (Endomed, USA)	2	5	n.a.	n.a.
Welltech (Welltech, PRC)	2	n.a.	n.a.	35–100
Griking (Grikin, PRC)	1	n.a.	28–36	130–150
Unknown homemade bands	7	17	n.a.	n.a.

[a] One institute may use more than one kind of stent grafts. Information about the type of stent grafts were absent in 8 institutes.
[b] It is a sum up of available numbers, as only 12 institutes reported the exact number of stent grafts used.

Table 5 Causes of in-hospital death

Causes	Number (*n*)	Rate (%)
Rupture of the dissection	8	26.7
Ischemia-reperfusion injury	3	10
Cardiac tamponade	2	6.7
Cerebral embolism	2	6.7
Pulmonary infection	2	6.7
Toxic shock	2	6.7
Myocardial infarction	1	3.3
Ischemia of brain stem	1	3.3
Renal failure	1	3.3
Cardiac arrest	1	3.3
Cardiac arrhythmia	1	3.3
Mesenteric artery embolism	1	3.3
Cerebral hemorrhage	1	3.3
Unknown reason	3	10
Data not available	1	3.3
All	30	100

97.3 ± 1.1% at 30 days, 94.8 ± 1.5% at 1 year, 93.9 ± 1.8% at 2 years and 91.2 ± 2.6% at 3 years, respectively (Fig. 1).

Acute versus chronic dissection

Of the total 35 studies, 18 specified whether stent-graft placement was carried out for acute or chronic type B-AD (Table 7). For the overall complications, major complications, minor complications, procedure-related complications, stroke, paraplegia or 30-day mortality, there was no significant difference between the acute and chronic groups.

Discussion

Although dramatic improvement in operative techniques, anesthesiological methods, and medical therapy has been made in recent years, type B-AD still remains a challenging problem for vascular surgeons. Endovascular stent-graft placement for type B-AD has achieved encouraging short- and mid-term outcomes widely. Our study summarised all the data on endovascular stent-graft placement for type B-AD currently available in China. The in-hospital mortality was 2.1 ± 0.4%. Because of incomparability of patients, these early mortality rates cannot be compared with the results of open surgery. Surgical mortality ranging from 6.1% to 14% have been reported in two largest cardiovascular centres in China.[41,42]

Table 6 Follow-up data after stent-graft placement

	Data available (*n*)	Number of events (*n*)
Duration of follow-up (months)	641	24.0 ± 16.1
False lumen thrombosis	431	363 (84.2 ± 1.6%)
Post-discharge surgical conversion	416	2 (0.5 ± 0.04%)
Adjunctive endovascular procedures	419	3 (0.7 ± 0.2%)
Post-discharge complications	508	16 (3.1 ± 0.8%)
Post-discharge mortality	830	7 (0.8 ± 0.1%)
Persistent endoleak	660	10 (1.5 ± 0.3%)
Emerging aortic dissection	740	5 (0.7 ± 0.4%)
Stent migration	451	2 (0.4 ± 0.2%)
Post-discharge retrograde type A-AD	738	3 (0.4 ± 0.1%)

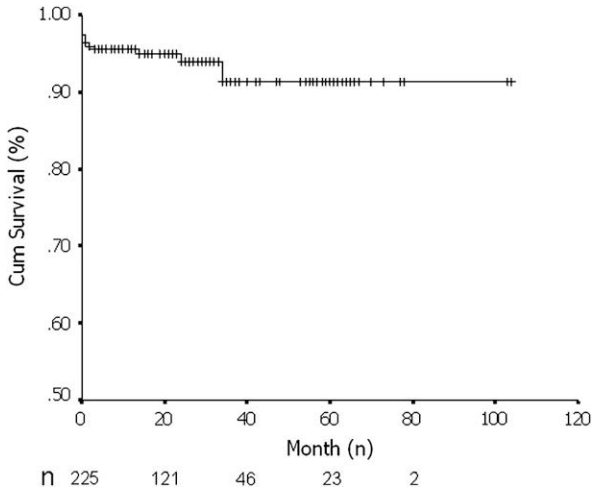

Figure 1 Kaplan-Meier estimate of overall survival.

Neurological deficits are the most devastating complications of open repair for type B-AD. The International Registry of Acute Aortic Dissection investigators[43] reported neurological deficits in 23.2% of the patients treated by traditional surgery, with cerebrovascular accident in 9.0% and paraplegia in 4.5%, respectively. The paraplegia rates for endovascular treatment of aortic dissections were reported much lower as 0.8% in the EUROSTAR trial.[44] In our study, no paraplegia occurred during hospitalization and only one case happened occurred after discharge, yielding an overall morbidity of 0.1%. Considering that only 1.1 stents were used per patient, we mainly attribute the low risk of paraplegia to the short length of thoracic aorta covered, as well as avoidance of aortic cross-clamping and subsequent reperfusion. When sufficient sealing of the primary entry tear can be achieved, using fewer stents to avoid long segment coverage can help to decrease the morbidity of paraplegia.

Insufficient length of the proximal landing zone remains a challenge for completely excluding the entry tear of the dissections. There is still a controversy on the safety of intentional overstenting the LSA.[45–47] Our data suggest that stent graft-induced occlusion of the LSA can be well tolerated by the majority of patients, with an acceptably low morbidity of neurological complications and mortality. In the condition of patent and dominant contralateral vertebral and a documented intact vertebrobasilar system, re-vascularisation of the LSA is not required prior to intentional coverage of the LSA.

Several studies have demonstrated higher in-hospital mortality and major complication rates for type B-AD treated with endovascular repair in the acute phase

Table 7 Comparison of acute versus chronic dissection.

	Data available (n)				p
		Acute AD ($n = 356$)		Chronic AD ($n = 289$)	
Age (years)	146	50.6 ± 5.2	49	56.2 ± 5.9	0.233
Male gender	146	$82.2 \pm 0.7\%$	49	$79.6 \pm 0.3\%$	0.685
In-hospital surgical conversion	356	0%	267	0%	———
Overall complications	117	$18.8 \pm 2.0\%$	43	$9.3 \pm 0.9\%$	0.149
Major complications	224	$0.9 \pm 0.3\%$	206	0%	0.500
Minor complications	102	$18.6 \pm 1.8\%$	43	$9.3 \pm 0.9\%$	0.160
Procedure-related complications	184	$1.1 \pm 0.2\%$	145	$0.7 \pm 0.2\%$	1.000
Retrograde type A-AD	267	$0.4 \pm 0.1\%$	218	0%	1.000
Access complications	174	$0.6 \pm 0.1\%$	145	$0.7 \pm 0.2\%$	1.000
Stroke	194	0%	208	0%	————
Paraplegia	356	$0.3 \pm 0.1\%$	267	0%	1.000
30-Day mortality	257	$3.1 \pm 1.3\%$	185	$2.2 \pm 0.2\%$	0.521[a]

[a] Log-rank test.

compared with the chronic phase.[3,48,49] Less stable clinical status of the patients in the acute phase is considered as the most important determinant of worse survival.[49] The complicated conditions of rupture and malperfusion are also important predictors of early mortality.[50] These may explain the worse results in the acute group. In the initial period, considering the poor anti-hypertensive drug compliance and low rate of effective hypertension control in China,[51] a few of the stable uncomplicated patients were treated in the acute phase. This might explain the comparable outcomes in the acute group with the chronic group. However, following the current global consensus on acute type B-AD,[52] endovascular repair in China has lately been strictly reserved for cases complicated with rupture, malperfusion syndrome and intractable hypertension and pain. Intensive medical treatment for stable cases should be emphasised in the future.

Cost-effectiveness is another issue that is of concern. The most commonly used imported stents in China such as Talent (Medtronic, USA) and Zenith (Cook, USA) are quite expensive (about $15 000 per stent) and only a small proportion of patients in China can afford the cost. In the past 5 years, several homemade stents such as Hercules & Aegis (MicroPort, PRC) with a much lower price (about $7500 per stent) have emerged as an alternative with encouraging short-term results.[15,18,30,36] More homemade stents will be used to increase the availability of stents for the relatively poor patients. However, meticulous studies are warranted to study the long-term complications and durability of the homemade stents.

As the morbidity of type B-AD is increasing in China, some demographics different from the European and American countries, such as a much younger age and sex ratio, have been observed.[53] This indicates that a multi-centre randomised controlled tests to further study the endovascular repair for type B-AD in comparison to medical treatment or traditional surgery are required, and then to develop a practice guideline that is more adapted to Chinese patients in the coming years.

Nevertheless, limitations of our study should be pointed out. It is the selection of patients from observational series that may have a low representation. The relatively low percentage of studies with data available for some valuable parameters might further lower the representation and increase the selection bias. In some articles the definitions and primary data are ambiguous, which to some degree impair the statistical power and decrease the reliability of this study.

Conclusion

In conclusion, our study shows that stent-graft placement of type B-AD is feasible with high procedure success rate and acceptably low complication rates. Both early and mid-term outcomes appear to be encouraging. Reasonably reducing the number of stent graft used can help to lower the morbidity of paraplegia. Intentional coverage of the LSA is safe for extending the short landing zone when contralateral blood distribution to the brain is sufficient.

Conflict of interest

None.

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References

1 Dake MD, Kato N, Mitchell RS, Semba CP, Razavi MK, Shimono T, et al. Endovascular stent-graft placement for the treatment of acute aortic dissection. *N Engl J Med* 1999;**340**:1546—52.
2 Nienaber CA, Fattori R, Lund G, Dieckmann C, Wolf W, von Kodolitsch Y, et al. Nonsurgical reconstruction of thoracic aortic

dissection by stent-graft placement. *N Engl J Med* 1999;**340**: 1539—45.
3 Eggebrecht H, Nienaber CA, Neuhauser M, Baumgart D, Kische S, Schmermund A, et al. Endovascular stent-graft placement in aortic dissection: a meta-analysis. *Eur Heart J* 2006;**27**:489—98.
4 Wang ZG, Chen XM, Yu J, Wang SH. Endovascular repair of aortic dissection aneurysm with stenting graft. *Chin J Gen Surg* 1999; **8**:403—6.
5 Jing ZP, Bao JM, Zhou YQ, Zhao ZQ, Xu B, Feng X. Endovascular stent exclusion for thoracic aortic dissections. *Acad J Sec Mil Med Univ* 1999;**20**:828—30.
6 Jing ZP, Feng X, Bao JM, Zhao ZQ, Zhao J, Lu QS, et al. Endovascular stent-graft exclusion for Stanford B type aortic dissections: a report of 146 patients. *Chin J Surg* 2003;**41**: 483—6.
7 Zhang XM, Zhang XM, Li W. Endovascular treatment of aortic dissection using stent-graft: report of 45 cases. *Chin J Pract Surg* 2003;**23**:742—4.
8 Wu QZ, Li DM, Liang W, Li C. Treating Stanford B aortic dissection with minimally invasive stent-graft placement (with 15 cases). *J Chin Phys* 2004;**6**:803—4.
9 Zhang XT, Zhang Q, Xu K, Li H, Xiao L, Wang SL, et al. Endovascular stent-graft implantation for Stanford B type thoracic aortic dissection. *Chin J Med Imaging Technol* 2004; **20**:925—8.
10 Li HX, Zhou CW, Guo LM, Zi J, Wang ZJ. Treatment of type B aortic dissection with polyester-covered stent-grafts. *Shandong Med J* 2004;**44**:1—2.
11 Shi Y, Fu WG, Wang YQ, Xu X, Guo DQ, Chen B, et al. Review of 150 cases of Stanford type B aortic dissection aneurysms treated by endovascular placement of stent-grafts. *J Surg Concepts Pract* 2005;**10**:45—9.
12 Ling Q, Weng DG, Wang T, Zhao P. Endovascular repair on aortic dissecting aneurysm. *J Chin Phys* 2005;**7**:1334—5.
13 Zhang GS, Li XQ, Zhang J. Mini-traumatic therapy of endovascular graft exclusion for aortic dissection. *Chin J Interv Imaging Ther* 2005;**2**:370—2.
14 Guo W, Gai LY, Liu XP, Zhang GH, Liang FQ, Li R. The endovascular repair of aortic dissection: early clinical results of 178 cases. *Chin J Surg* 2005;**43**:921—5.
15 Shan SJ, Chen SL, Ye F, Luo J, Zhang JJ, Lin S. Endovascular exclusion repair of thoracoabdominal aortic dissection and follow-up. *J Clin Cardiol (China)* 2005;**21**:657—9.
16 Su JL, Han YN, Li XD, He JX. Intravascular interventional treatment for thoracic aortic dissection. *J Ningxia Med Coll* 2005;**27**:461—2.
17 Luo JF, Liu Y, Fan RX, Huang WH, Huang MP, Li G, et al. Endovascular stent-graft exclusion for patients with DeBakey III aortic dissection. *J Clin Cardiol (China)* 2006;**22**:41—3.
18 Hasan A, Ma YT. Vascular stent-graft exclusion for Stanford B type aortic dissections: a report of 25 patients; 2006.
19 Li C, Li YL, Wang ZG, Zhang Q. Aorta-left subclavian artery branched endovascular stent-graft repair for Stanford type B aortic dissection. *Chin J Thorac Cardio Vasc Surg* 2006;**22**:152—4.
20 Zhao JP, Luo YD, Gao SH. Endovascular aortic stent-graft placement for treatment of Stanford type B aortic dissection: experience of 15 cases. *Radiol Pract* 2006;**21**:600—2.
21 Tan YC, Luo CH, Xu GJ, He ZJ, Zhu ZR. Vascular intracavitary treatment in 15 type III dissected aneurysm of aorta. *Lingnan Mod Clin Surg* 2006;**16**:214—6.
22 Qian J, Jiang CQ, Zhang XM. Clinical study of coated stent-graft in treatment of acute aortic dissection. *J Intern Intensive Med* 2006;**12**:210—2.
23 Lu ZX, Zhu PX, Li AG, Zhang Y, Zhang FQ, Gao JZ, et al. Endovascular stent-graft placement for 17 patients with Stanford B aortic dissection. *Shandong Med J* 2006;**46**. 51—51.
24 Li J, Wang MH, Liu TQ, Liu LQ, Ma YP. Endovascular repair of Stanford B aortic dissection. *Shandong Med J* 2006;**46**. 64—64.
25 Yu FC, Huang LJ, Sun LZ. Endovascular stent-graft placement for treatment of type B dissections. *Chin Circ J* 2006;**21**: 266—9.
26 Wang L, Tong XQ, Han ZW. Endovascular stent-graft repair of descending thoracic aortic dissection. *Chin J Cardiovasc Rev* 2006;**14**:764—5.
27 Luo JG, Xiao EH, Zhou SK. Endovascular graft exclusion for thoracic aortic dissections. *J Clin Radiol (China)* 2006;**25**: 1046—50.
28 Pang ZQ, Zhang WJ, Gao JS, Li C, Zheng XM. Follow-up of the effects of treating aortic dissection: with China-made endovascular stent: analysis of 12 cases. *Chin J Emerg Resusc Disaster Med* 2006;**1**:214—5.
29 Chang GQ, Li XX, Chen W, Li JP, Hu ZJ, Yao C, et al. Early and midterm results of endovascular repair of aortic dissection: report of 165 cases. *Chin J Surg* 2008;**46**:752—5.
30 Sheng W, Chi YF. Treatment of Stanford B type thoracic aortic dissection with endovascular stent-graft in 18 cases. *Chin Heart J* 2007;**19**:491—2.
31 Zhang WL, Liu S, Chen ZY, Shi FW, Liu LL. Treating with DeBakey III aortic dissection with stent graft in 17 cases. *J Fourth Mil Med Univ* 2007;**28**. 44—44.
32 Yang M, Zhang JW, Chen P, Sun L, Che HJ, Yong J. The efficacy of endovascular covered stent-graft for dissection of aorta. *Med J Qilu* 2007;**22**:51—2.
33 Wang JP, Yang DK, Dong Y, Li YC, Yuan SG, Zhang ZT, et al. Clinical experience and study on the treatment of thoracic aortic dissecting aneurysm (Stanford B Type) with endovascular stent. *Radial Pract* 2007;**22**:289—91.
34 Dong YF, Cao WF, Su HW, Dong SQ, Jiang JF. Endovascular stent-graft exclusion for the treatment of descending aortic dissection. *Med J NDFNC* 2007;**28**:186—8.
35 Luo FY, Jiang HH, Lin GQ, Wang L, Chen R. Treatment of Stanford B type thoracic aortic dissection with endovascular stent-graft in sixteen cases. *Chin Med Eng* 2007;**15**:582—4.
36 Zhang W, Yang JG, Zhao M, Hu YM, Zhang HB, Li YJ. The analysis of effect of treating Stanford B with domestic stent graft. *Clin Foc (China)* 2007;**22**:1177—8.
37 Dai JM, Wang JY, Jiang N, Jiang L, Wei D. Endovascular stent-graft treatment of acute or chronic Stanford type B aortic dissection in 68 cases. *Chin J Cardiovasc Med* 2007;**12**: 292—3.
38 Yang RM, Zhao BS, Li FB, Zhang LJ, Zhang XZ, Sun JM, et al. Endovascular stent in the treatment for aortic dissecting aneurysm. *J Pract Radiol* 2007;**23**:1224—6.
39 Jing QM, Hang YL, Wang XZ, Deng J, Luan B, Jin HX, et al. Endovascular repair treat patient with acute and chronic aortic dissections. *Int J Surg* 2007;**34**:749—52.
40 Zhu YF, Zhu YB, Wu YB, Guo HW, Di DM, Zhang XY. Endovascular repair of Stanford B aortic dissection: a report of 12 cases. *Nanjing Med Univ J* 2007;**27**:1332—4.
41 Chang Q, Sun LZ, Zhu JM, Qian XY, Zheng J, Feng J. Surgical treatment of DeBakey type Ill aortic dissection. *Chin J Surg* 2002;**40**:740—2.
42 Zhang YQ, Zhang HJ, Dong PQ, Xie JS, Hou XT. Surgical treatment for thoracic aortic dissection-surgical indications, strategy and outcomes. *J Cardiovasc Pulm Dis* 2003;**22**:5—7.
43 Trimarchi S, Nienaber CA, Rampoldi V, Myrmel T, Suzuki T, Bossone E, et al. Role and results of surgery in acute type b aortic dissection: insights from the International Registry of Acute Aortic Dissection (IRAD). *Circulation* 2006;**114**:357—64.
44 Leurs LJ, Bell R, Degrieck Y, Thomas S, Hobo R, Lundbom J, EUROSTAR; UK Thoracic Endograft Registry collaborators. Endovascular treatment of thoracic aortic diseases: combined experience from the EUROSTAR and United Kingdom Thoracic Endograft registries. *J Vasc Surg* 2004;**40**:670—80.
45 Rehders TC, Petzsch M, Ince H, Kische S, Korber T, Koschyk DH, et al. Intentional occlusion of the left subclavian artery during

stent-graft implantation in the thoracic aorta: risk and relevance. *J Endovasc Ther* 2004;**11**:659—66.

46 Reece TB, Gazoni LM, Cherry KJ, Peeler BB, Dake M, Matsumoto AH, et al. Reevaluating the need for left subclavian artery revascularization with thoracic endovascular aortic repair. *Ann Thorac Surg* 2007;**84**:1201—5 [discussion 1205].

47 Woo EY, Carpenter JP, Jackson BM, Pochettino A, Bavaria JE, Szeto WY, et al. Left subclavian artery coverage during thoracic endovascular aortic repair: a single-center experience. *J Vasc Surg* 2008;**48**:555—60.

48 Kato N, Shimono T, Hirano T, Suzuki T, Ishida M, Sakuma H, et al. Midterm results of stent-graft repair of acute and chronic aortic dissection with descending tear: the complication-specific approach. *J Thorac Cardiovasc Surg* 2002;**124**: 306—12.

49 Eggebrecht H, Herold U, Kuhnt O, Schmermund A, Bartel T, Martini S, et al. Endovascular national stent-graft treatment of aortic dissection: determinants of post-interventional outcome. *Eur Heart J* 2005;**26**:489—97.

50 Estrera AL, Miller 3rd CC, Safi HJ, Goodrick JS, Keyhani A, Porat EE, et al. Outcomes of medical management of acute type B aortic dissection. *Circulation* 2006;**114**(Suppl. 1):I384—9.

51 Wu Y, Huxley R, Li L, Anna V, Xie G, Yao C, et al. Prevalence, awareness, treatment, and 51 he thoracic aorta: risk and control of hypertension in China: data from the China National Nutrition and Health Survey 2002. *Circulation* 2008;**118**:2679—86.

52 Svensson LG, Kouchoukos NT, Miller DC, Bavaria JE, Coselli JS, Curi MA, et al. Society of Thoracic Surgeons Endovascular Surgery Task Force. Expert consensus document on the treatment of descending thoracicaortic disease using endovascular stent-grafts. *Ann Thorac Surg* 2008;**85**(Suppl. 1):S1—41.

53 Xue L, Luo JF, Mai JZ, Luo XQ. Change trend of dinical characteristics of aortic dissection 52 over 10 years. *Chin J Cardiol* 2007;**35**:47—50.